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BELTSVILLE DIVISION

Evaluation of

CONSTRUCTION, MATERIALS, AND LIVABILITY

of Five Expansible Farmhouses



Growth Through Agricultural Progress

AGRICULTURAL RESEARCH SERVICE
U. S. DEPARTMENT OF AGRICULTURE

PREFACE

This publication is one of a series to be issued covering studies in five expandable-type houses built at the Agricultural Research Center, Beltsville, Maryland, in 1952, 1953, and 1954. The houses have been occupied most of the time since they were constructed and thus the research on them includes "in-use" performance characteristics of various kinds of materials, construction, and heating systems. Family reaction to these characteristics and to certain construction features, as well as the climatic responses of the various houses are important aspects of the research conducted in the house.

The Clothing and Housing Research Division and the Agricultural Engineering Research Division of the Agricultural Research Service cooperated on certain phases of the program.

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EVALUATION OF CONSTRUCTION, MATERIALS, AND LIVABILITY OF FIVE EXPANSIBLE FARMHOUSES

Archie A. Biggs and Joan C. Courtless,
Agricultural Engineering Research Division and
Clothing and Housing Research Division, respectively,
Agricultural Research Service

INTRODUCTION

The construction of five expansible farmhouses was started at the Agricultural Research Center, Beltsville, Md., in 1952. The houses were built primarily to house dairy workers. They also provided opportunity for observing experimental construction methods and materials and evaluating the livability of interior designs of small houses. Plans for the houses were prepared by the Divisions of Agricultural Engineering Research and the Clothing and Housing Research.

The primary research objectives were to obtain information on (1) effectiveness of certain building materials and heating installations, (2) livability of the basic and expanded floor plans as determined by observations and reactions of the occupants, (3) climatic responses of the various building designs and materials and effect on fuel requirements, and (4) possible cost reduction through simplified construction methods which would be consistent with good practice and be available to the average farmer-builder.

This report, a joint endeavor of the two Divisions that planned the expansible houses, is concerned with the first two objectives. It evaluates the designs and various construction features and materials of the houses in terms of ease of building maintenance, general acceptance by the occupants, and the most recent research findings on space requirements.

Details of wall and roof construction, foundation, insulation, amount of glass area, placement and operation of windows, interior wall and floor finishes, and heating equipment are discussed in relation to objective (1). Problems encountered in building two of the houses in their expanded form are also enumerated.

In evaluating livability, one criterion was the reactions of the families living in the houses. Information from the families was obtained in personal interviews under friendly, informal conditions. Each homemaker was interviewed in her home during March 1959.

The points on which opinions were obtained are as follows:

Appearance of house exterior

Temperature, ventilation, lighting and sound conditions

Kitchen--

Location in plan

Amount of storage space

Size

Convenience of storage

Amount of counterspace

Adequacy of space for equipment desired

Countertop material

Placement of electrical outlets

Cabinet design

Flooring material

Dining area--

Location in plan

Size

Type of divider between living and dining areas

Living area--

Space in relation to furniture arrangement

Flooring material

Utility area--

Location of laundry facilities
Adequacy of space for laundry facilities
Convenience of arrangement

Lack of closure between laundry and adjacent areas
Adequacy of storage space

Bathroom--

Location in plan
Wall surface finish
Space for cleaning fixtures, walls, and floors

Placement of fixtures
Flooring material

Sleeping area--

Number of bedrooms
Size of bedrooms
Space in relation to furniture arrangement
Clothing storage facilities

Storage facilities--

What kinds of items are stored¹
Where they are stored
Adequacy of storage space for each kind of item
Convenience of storage space for each kind of item

Family activities: TV viewing; studying, reading, and home business; ironing; entertaining; sewing; drying clothes in winter; hobbies; children's play--

Which activities were performed
Adequacy of space for each activity performed
Preferred location for each activity performed

Opinions of the homemakers frequently reflected the personal preferences and requirements of their families. In some instances dissatisfactions have occurred because the family living in the house differs in composition from the type of family for which the house was originally designed and is suitable. For these reasons some of the livability features listed above were omitted in the evaluation of one or more of the individual houses.

Livability was evaluated also on the basis of recently established space standards for farmhouses. At the time the five expansible houses were designed and constructed there was meager information concerning the kind and amount of space needed for household activity and storage areas in rural homes. Since then, space standards for kitchens, dining areas, bathrooms, laundry areas, clothing storage and linen storage have become available as a result of a coordinated program of housing research conducted cooperatively by the U. S. Department of Agriculture and Agricultural Experiment Stations in the four regions. In evaluating the expansible farmhouse designs in relation to space requirements, each floor plan was examined to determine whether any specific activity areas or storage facilities failed to meet the minimum recommendations established through this research. Because no research on bedroom space requirements has yet been published, recommendations made by the Federal Housing Administration and the American Public Health Association were used in appraising sleeping areas. The Federal Housing Administration's minimum specifications for kitchen shelving and countertop areas were incorporated in the description of each kitchen for additional comparisons, even though research standards, used in the evaluation, were higher.

Special consideration was given the evaluation of the basic units of these expansible houses because they should have--

- Living, dining, and kitchen areas sized in relation to the requirements for space in the house when it is expanded

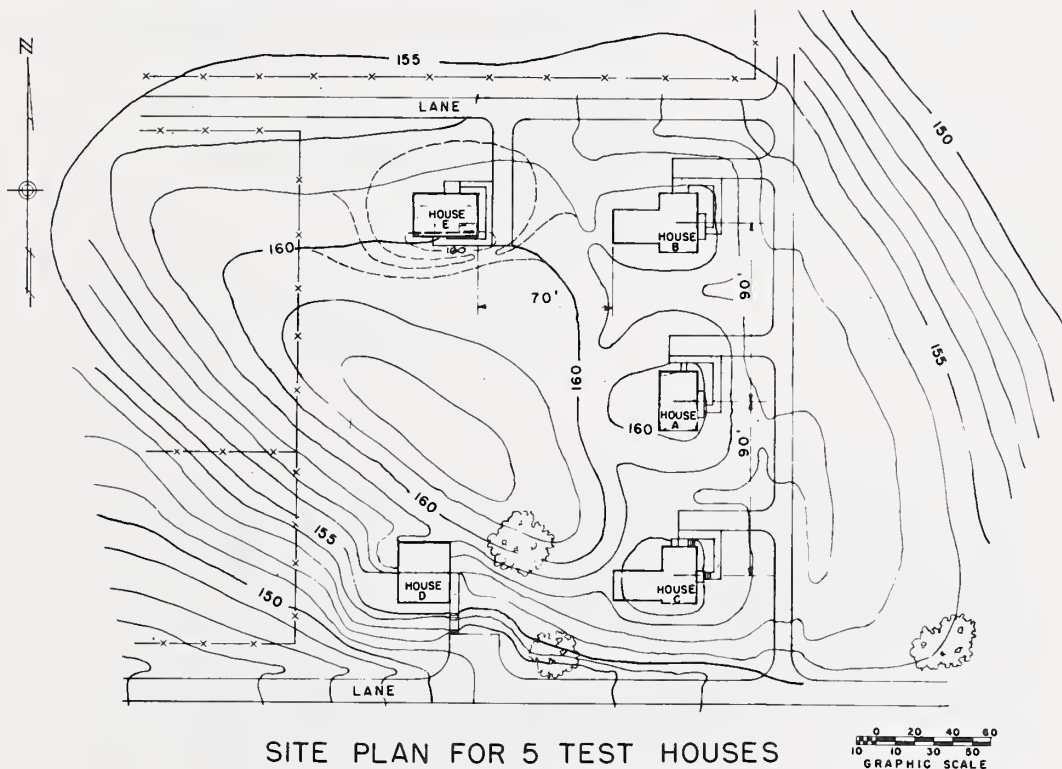
¹ All families stored the following articles:

Coats	Out of season clothes	Bathroom supplies	Cleaning supplies
Work clothes	Bedding	Toilet articles	Lawn equipment
Clothing in current use	Table linen	Cleaning equipment	

- Storage facilities sized in relation to requirements of the house when expanded. Exact dimensions will be determined by the number and location of storage facilities within the expanded house.

Results of the evaluation are included in the discussion of the individual houses. The actual dimensions of the various activity and storage areas in each house, together with the standards with which they were compared, are given in the appendix.

The site plan of the five houses is shown in figure 1. Basic units of three houses were constructed; these are House A with no separate bedroom, House D with two bedrooms, and House E with one bedroom. Houses B and C were constructed in an expanded form with two bedrooms added to the basic units. Expansion of House D to include a third bedroom is contemplated when funds become available.



SITE PLAN FOR 5 TEST HOUSES

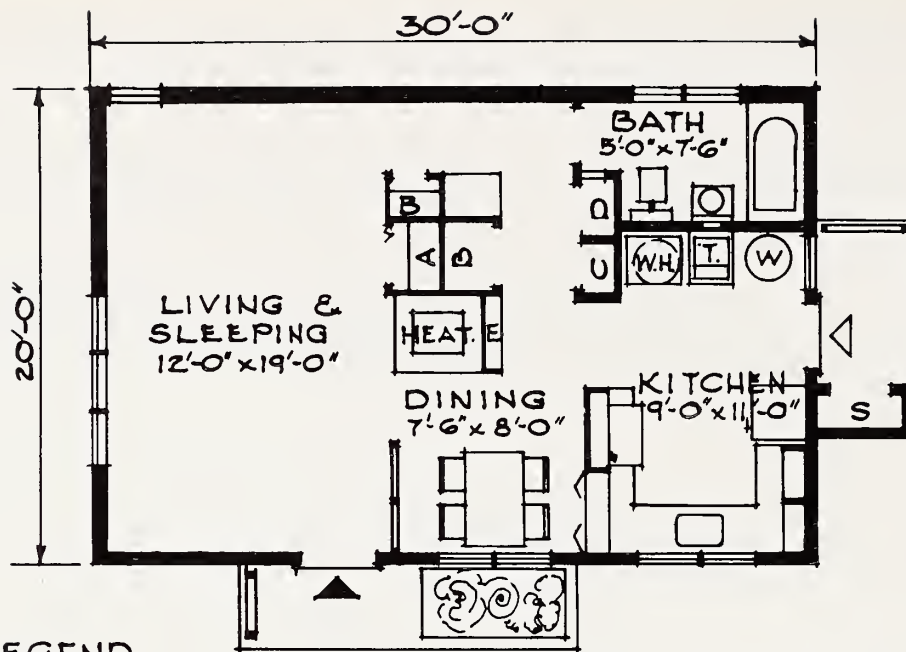
FIGURE 1.--Site plan of five houses.

DESCRIPTION AND EVALUATION OF HOUSES

House A

Construction and Materials

Description.--House A is a wood framehouse with wall studs 24" on center (o.c.), covered on the outside with 4' x 8' sheets of asbestos-cement board (fig. 2). Lightweight trusses and wood sheathing covered with felt and asphalt shingles make up the roof which has a 3-foot overhang. The roof was built originally without gutters, but one was subsequently installed across the front of the house to prevent rain being driven in under the entrance door during northeasterly storms. Both walls and ceiling have 2 inches of insulation. The interior finish is painted drywall. The bathroom wainscot is of aluminum tile.



LEGEND

A-COATS
 B-OTHER CLOTHES
 C-WORK CLOTHES
 & CLEAN. EQUIP.
 D-LINEN
 E-BOOKS

COUNTER TOP-LAMINATED PLASTIC
 FLOOR COVERING ON CONC. SLAB
 BATH-VINYL TILE
 ALL OTHER-ASPHALT



FIGURE 2.--House A.

The floor is concrete slab with reinforced concrete grade beam supported by 18" diameter concrete piers (fig. 3). Experimental at the time the house was constructed, grade beam construction has since been adopted widely, and its use was recently approved and incorporated in the Minimum Property Standards of the Federal Housing Administration (2).² Applied directly on grade under the floor slab was 45-pound roll roofing which serves as a vapor barrier.

The studs serve as jambs for the frameless windows and sash is hinged at top to provide ventilation (fig. 4). This house has two large window areas: one 7'-6" wide by 6'-6" high in the south wall of the living-sleeping room; and one 5'-0" wide by 6'-6" high in the dining area--an eastern exposure. Both windows have 1'-6" sill heights. Other windows are of conventional size.

Heat is provided by a circulator heater using kerosene.

Technical evaluation.--Asbestos-cement board covering the exterior walls shows no signs of deterioration, cracks, or discoloration, and presents an attractive surface which is relatively maintenance free.

A crack appeared near the center of the ceiling continuing practically from wall to wall beneath the ridge. Inspection revealed a measured deflection of 1/4" near the crack; this is slightly more than normal camber but is not alarming. Because a vapor barrier was applied over the insulation in the attic as an experimental feature, the plasterboard softened from high-moisture content. The size of the crack, caused by structural movement, was thus increased when the plasterboard dried out.

The concrete grade beam showed no cracks approximately 7 years after construction. Vertical movement of the beam has been slight as indicated by periodic elevation readings over a period of about 3 years.

The frameless windows tend to admit dust more readily than conventional type sash.

This house is the easiest of the five houses to heat, principally because it is the smallest. The circulator heater provides ample heat when adjusted to its lowest consumption.

Comments and criticisms by occupants.--The concrete floor, though covered with resilient tile, contributes to a feeling of tiredness after short periods of standing.

The large window on the south side admits excessive light and sun which fades the upholstery and rug and causes discomfort in warm weather.³

Livability

Description of interior design.--The house has a combined living and sleeping room, U-shaped kitchen with pass-through to separate dining area, utility wall opposite kitchen work area, and bathroom (fig. 2). There are six interior closets for: coats (A), other clothes (B), work clothes and cleaning equipment (C), linens (D), plus space for miscellaneous storage above closets A and B, and shelf space for books and others (E).⁴ An additional utility-type storage unit is located outside the kitchen door.

The kitchen has 11½ linear feet of wall cabinets, 10 linear feet of base cabinets and drawers (exclusive of under-sink and under-range storage), and 11½ linear feet of counterspace. This is approximately double the minimum shelf and countertop areas for kitchens as specified in the Federal Housing Administration's Minimum Property Standards of November 1958. Kitchen cabinets were carpenter-built, and to demonstrate

² Figure in parentheses refer to Literature Cited at end of this report.

³ This condition could be improved with some sort of outdoor shading or a different window drapery treatment.

⁴ Letters refer to corresponding letter identification of storage facilities shown on house plan (fig. 2).

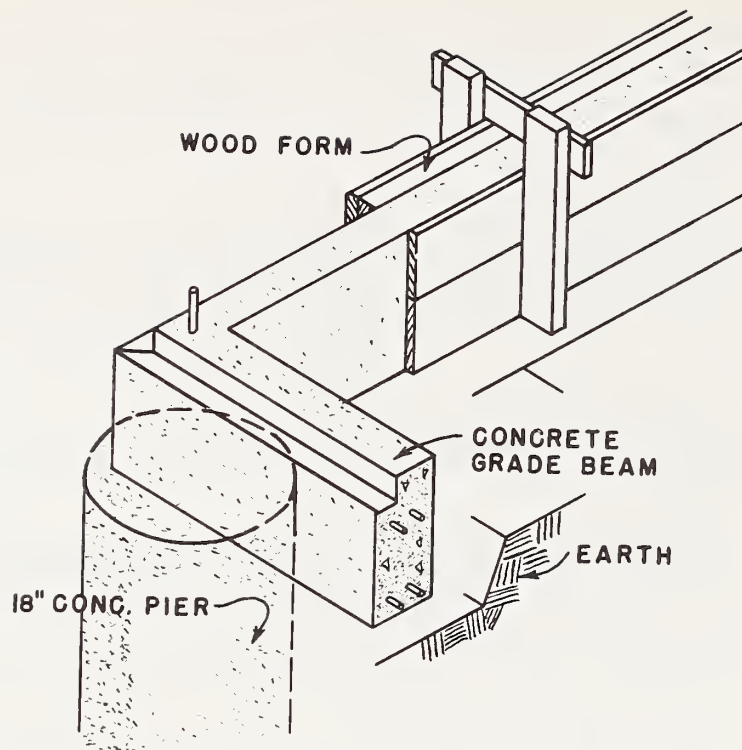


FIGURE 3.--Concrete grade beam, House A.



FIGURE 4.--Frameless window jambs, House A.

possible economies in original construction, doors were not installed in wall cabinets, though they were included in the design (fig. 5).

In the utility area a countertop-model water heater provides extra work space adjacent to the laundry tray. Wall space for storage cabinets is available over the laundry equipment, but to date shelves or cabinets have not been installed.

The dining area is separated from the kitchen by a solid partition behind the range and a dish cabinet that opens on both the dining area and kitchen sides of the wall. A pass-through over the kitchen counter permits energy-saving meal service. Undercounter space in the corner of the kitchen is fully utilized by drawers and cabinets opening into the dining area. These were planned for table linens, flatware, and sewing supplies. Separating the dining and living area is a stationary grille (fig. 6). This gives the occupants a focal spot for favorite decorative accessories. In addition, visual limits to each area are established without contributing to a feeling of confinement that would result from a solid partition.

The linen closet (D) was designed so that towel shelves could be reached both from the hall and from within the bathroom. The bathroom window is located so that it can be operated without reaching over any of the fixtures.

A house of this size, with the combination living and sleeping room, is best suited for a young couple who haven't yet accumulated the number of the single-purpose type of furnishings which fit into a larger house. The occupants of House A are an elderly couple whose previous experience has been renting somewhat larger houses with basement and porches, and who brought to this house separate living room and bedroom furniture. They had lived here for 1 year at the time this study was initiated.

Evaluation by occupants.--The homemaker was generally pleased with the kitchen, utility area, dining area, bathroom, and storage areas throughout the house. Her suggestions as to how these might be improved were:

- (a) Doors on kitchen wall cabinets would keep dishes cleaner.
- (b) Space for a freezer would be desirable.
- (c) A larger linen closet to accommodate all bedding and bath linen.

She was not satisfied with the combination living and sleeping room. This reaction was due in part to the appearance of the double bed which was not concealed in any way from the living area. A different sleeping arrangement (such as shown in fig. 7) or some sort of screening device would alleviate this situation. Satisfactory arrangement of conventional furniture for both living room and bedroom is difficult to achieve in a room of this size. The occupants would prefer a separate bedroom but agree that livability of the combination room would be improved if it were larger.

Evaluation based on space standards.--The amounts of kitchen storage facilities and counter area are equal to or exceed the minimum recommended for a U-shaped kitchen with appliances positioned as they are in this house (5). Counterspace is sufficient for food preservation activities (3).

Since this house is expansible to two bedrooms, the dining area should suit the needs of at least four persons. The smallest dining area which accommodates four persons, serving on one end of the table only and with two persons seated on each side, is 7'-0" x 6'-0" (5). The dining area of house A measures 7'-6" x 8'-0".

The minimum dimensions for a laundry area equipped with an automatic washer, a dryer, and a stationary tub are 6'-8" wide by 5'-6" deep (plus space for connections) (5). House A's laundry area is 5'-0" wide and 6'-0" deep, too narrow for all three pieces of equipment.



FIGURE 5.--Doorless wall cabinets,
Houses A, B, and C.



FIGURE 6.--Wood grille,
Houses A and B.



FIGURE 7.--A possible solution for furnishing living and sleeping area, House A.

In the bathroom, space between the toilet and adjacent wall is 3 inches short of recently established minimum space recommendations (4). Other measurements pertinent to House A's bathroom compare favorably with recommended space allowances and are listed in the appendix.

Rods totaling 7'-6" in length are necessary in clothes closets to store the garments, other than coats and chore clothes, of a husband and wife.⁵ This house provides only 5'-0" of rod space, divided between two closets, for these clothes.

The closet for good coats should be large enough to suit the needs of the size family which could inhabit the house in its expanded state. House A is designed for expansion to two bedrooms. The coat closet, therefore, should accommodate the coats belonging to four persons, plus an allowance for guests' coats. A closet 2'-3" deep and with a rod 3'-6" long would be needed;⁶ one 2'-0" deep and 3'-0" wide is provided.

For limited supplies of bedding and bath linens a closet 2'-8" wide by 1'-8" deep is recommended (6). In this house the linen closet is 2'-2" wide and 1'-6" deep.

House B

Construction and Materials

Description.--House B (fig. 8) is built of 8" lightweight block. Cores of the blocks on the north and west walls of the basic unit were filled with expanded mica, but this was not done in the bedroom wing. The roof was constructed by covering lightweight trusses with

⁵ Unpublished data. Space Facilities Needed for the Storage of Clothing, Clothing and Housing Research Division, ARS, U. S. Department of Agriculture.

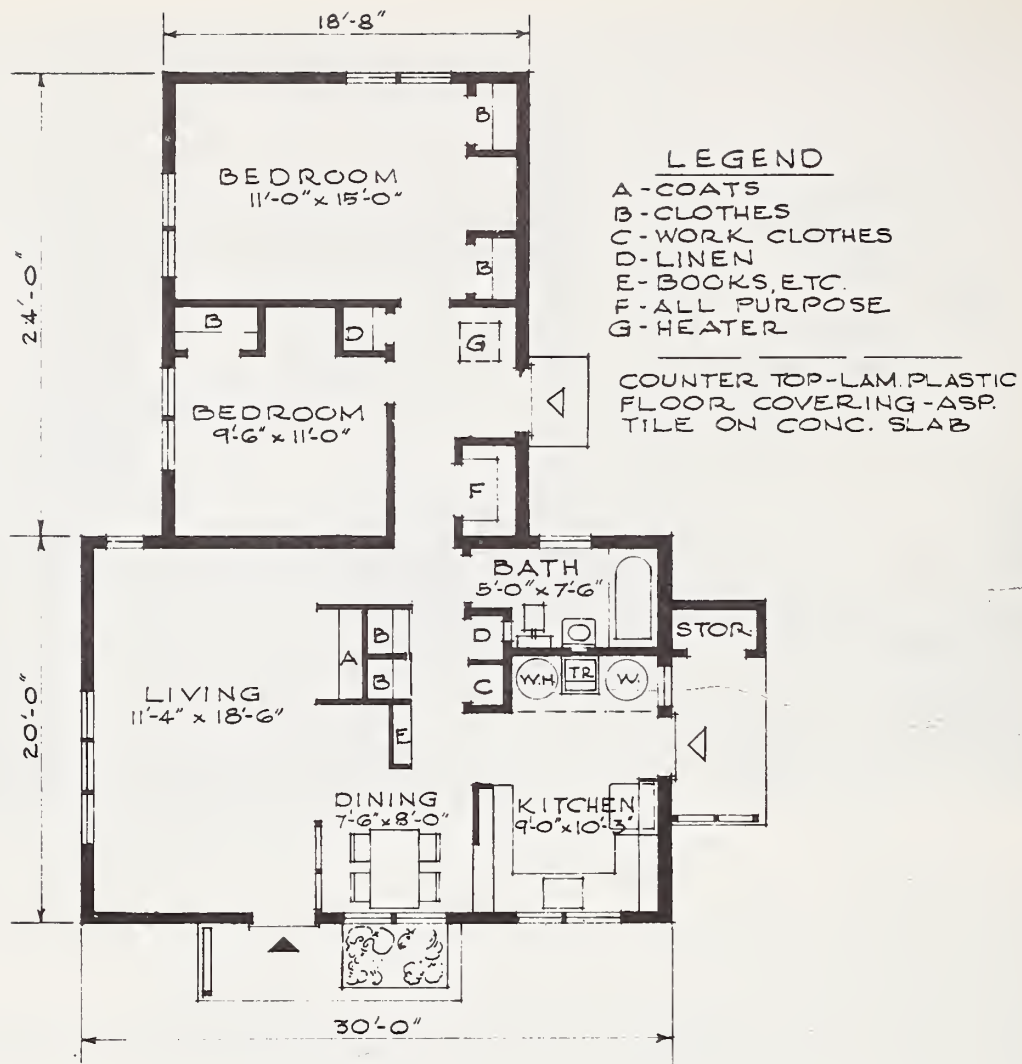


FIGURE 8.--House B.

wood sheathing and asphalt shingles. Gutters and downspouts are provided for the basic unit but not for the bedroom wing. Ceilings have 2 inches of insulation. The interior finish is gypsum plaster applied directly to the lightweight block and painted. Ceilings and partitions are gypsum lath and plaster, painted. The bathroom has a wainscot of plastic tile.

The concrete block foundation rests on footings 2 feet below grade. The concrete slab floor was laid over a tamped gravel fill, covered with rolled roofing vapor barrier.

Windows are double hung. Large window areas are in the living room, 8'-0" x 5'-2", a southern exposure, and in the dining area, 5'-4" x 5'-2", an eastern exposure. Both windows have 1'-6" sill heights.

A circulator heater using kerosene was installed in the basic house and a second heater of similar type was installed in the bedroom addition. These were replaced eventually by a central heating plant in the bedroom hall, the only available space large enough to accommodate it. Location of the furnace in a major passageway necessitated the installation of a short metal shield around the burner as a safety measure.

Technical evaluation.--Condensation on the west wall of the bedroom addition of House B has been a continual source of trouble in getting paint to adhere to the interior wall. This situation has not occurred in the basic unit of the house in spite of higher humidities which undoubtedly exist in the bathroom located in the northwest corner. Apparently the expanded mica insulation in the walls of the basic unit reduces the heat transfer sufficiently to relieve the condensation problem.

A crack, similar to that in House A (see page 5), appeared near the center of the ceiling in the basic unit. Length of crack, measured deflection, and probable cause are as described for House A.

Foundation, floor slab, and windows followed conventional methods of construction and have proven satisfactory.

Adapting a heating system to adequately heat the basic unit and the added bedrooms has presented the major problem in expanding this house. If circulator type heaters are used, space must be provided in the bedroom addition for a second heater. This in itself is a disadvantage in a house this small. Also, the second heater either must be connected by a fuel line to an outside storage tank or it will be necessary to carry kerosene into the house and fuel the heaters by hand. The alternative to circulator heaters is central heating installed at the time the house is expanded. Ducts for the future central heating system should be built into the basic unit. Installation after the structure is completed may be more difficult and therefore more costly. Installing duct work for the supply air system in House B required sheet metal men to work in cramped attic quarters, thereby adding to the cost by the increase in the time required to do the work. They were also unable to insulate the ducts as effectively as could have been done under normal conditions.

Comments and criticisms by occupants.--

- (a) Condensation on bedroom walls and floors due to high humidity is quite a problem in summer.
- (b) Gutters and downspouts to keep rain away from house are desirable for bedroom wing.⁶
- (c) The concrete floor, although covered with resilient tile, contributes to a feeling of tiredness after short periods of standing.
- (d) Quarter-round and mastic at base molding would help prevent cold air and insects from entering the house.⁶

⁶These items were named as the minor improvements most desired.

(e) The proximity of the heating plant to the bedrooms causes the occupants loss of sleep because of vibration and noise.

(f) Location of warm air vents, high on walls, keeps floors cold in winter.

Livability

Description of interior design.--The design of the basic unit of House B (fig. 8) is essentially the same as that of House A, described on pages 5 and 7. The combination living-sleeping room of House A forms the living room in House B. Other minor differences between the houses exist in the arrangement of clothes closets, the floor-to-ceiling screen that closes off the House B laundry area when it is not in use, and interior dimensions of living room and kitchen.

The bedroom addition contains two bedrooms, three clothes closets (B), a linen closet (D), and an all-purpose closet (F). An outside door from the bedroom hallway provides easy access to the backyard and farm buildings.

The master bedroom has 172 square feet; the second bedroom contains 108 square feet. The master bedroom has two clothes closets, separated by an alcove 4'-0" wide by 2'-4" deep; the second bedroom has a similar nook between the clothes closet and wall, 3'-9" wide by 2'-3" deep. The alcoves were planned to provide a convenient place for a dresser, chest of drawers, desk, or even a television.

This two-bedroom house is adequate for a couple with one child or two children of the same sex. It has been occupied for 2 years by a middle-aged couple with no children living at home. They previously had lived in a house that they owned which had three bedrooms, separate dining room, basement, screened porch, kitchen, and living room.

Evaluation by occupants.--The homemaker was generally satisfied with the house and stated that she would consider living permanently in a house of similar design. She had several suggestions, however, as to how specific areas and facilities could be made more useful and convenient. Two of these were identical to suggestions by the homemaker in House A:

(a) Doors on kitchen wall cabinets would keep dishes cleaner.

(b) Space for a freezer would be desirable.

All laundry was done at home; the homemaker had much difficulty drying clothes in winter and in poor weather. Comments on the utility area were:

(c) Space for automatic washer, dryer, and larger water heater would be desirable.

(d) Some sort of storage space, e.g., shelving, over the laundry equipment was needed for cleaning and laundry supplies.

A basement was desired by this family for the laundry activity, the freezer, and canned goods storage.

Storage facilities for table linens and lawn equipment were considered inadequate. One of the first changes in the house design the homemaker would make would be to increase the size of the outdoor storage closet.

When asked if satisfactory furniture arrangements could be attained in the bedrooms, the homemaker said she believed "nooks," created between closets or between closet and wall, limited the variety of arrangements and she regarded them as an undesirable feature.

Evaluation based on space standards.--Kitchen, laundry, dining, and bathroom areas are virtually the same as those in House A and the same criteria for adequacy apply (see pages 7 and 9).

In a two-bedroom house clothes closets in each bedroom should have a rod space 7'-6" long for garments stored on hangers other than coats.⁷ A coat closet 2'-3" deep with rod 3'-6" long will accommodate the coats belonging to four persons, plus an allowance for guests' coats. House B has 6'-6" of rod space in the master bedroom and 4'-0" of rod space in the second bedroom. The coat closet is 4'-0" wide and 2'-3" deep. Other closets for clothes, located in the basic unit, are 4'-0" wide, giving a total rod space of 18'-6" for the entire house; this is exactly the amount recommended.

There are two linen closets in this house: One in the basic unit, 2'-2" wide by 1'-6" deep, and one in the bedroom addition, 2'-0" wide by 2'-2" deep. These two provide even more space than required to store liberal quantities of bedding and bath linens--3'-2" wide by 1'-8" deep (6).

House C

Construction and Materials

Description.--House C (fig. 9) is wood frame with diagonal sheathing on the outside with vertical T & G siding and insulated with 2" batts. The roof is made by covering lightweight trusses with wood sheathing and asphalt shingles, and the ceiling has 2 inches of insulation. Interior walls are finished with gypsum lath and plaster, and painted.

Brick piers on concrete footings are set 2 feet below and extend 18 inches above grade. The piers support a double wood floor over a crawl space which is enclosed by an asbestos-cement curtain wall. The ground under the crawl space is covered with a vapor barrier of 55-pound roll roofing.

Windows are double hung. Pairs of windows, each 3'-0" wide by 4'-10" high, are located in the dining area, an eastern exposure, and on both the southern and eastern walls of the living room. Over the kitchen sink, facing west, are two windows each 2'-4" wide by 3'-6" high. All windows were fitted with louvered shade screens.

Circulator heaters using kerosene were installed in the basic unit and in the bedroom wing. These heaters subsequently were replaced by a central heating plant located close to the front entrance and enclosed to present a more pleasing appearance.

Technical evaluation.--As with Houses A and B, a crack appeared near the center of the ceiling in the basic unit, continuing practically from wall to wall beneath the ridge. Since the experiment of applying a vapor barrier over the ceiling insulation was tried in all three houses, the cause of the crack in House C is also attributed to structural movement, magnified when the plaster, softened from high-moisture content, eventually dried out.

Walls, foundation, and windows are of conventional design and construction and appear satisfactory.

The evaluation of the heating system in House C parallels that of House B (see page 11). When the central heating plant was installed in House C, it was necessary to notch the floor joists beneath the heater to permit installation of the return air duct. After 3 years there is no evidence of damage to the floor. It may be concluded, therefore, that the joists were not unduly weakened by the cutting.

⁷See footnote 5.

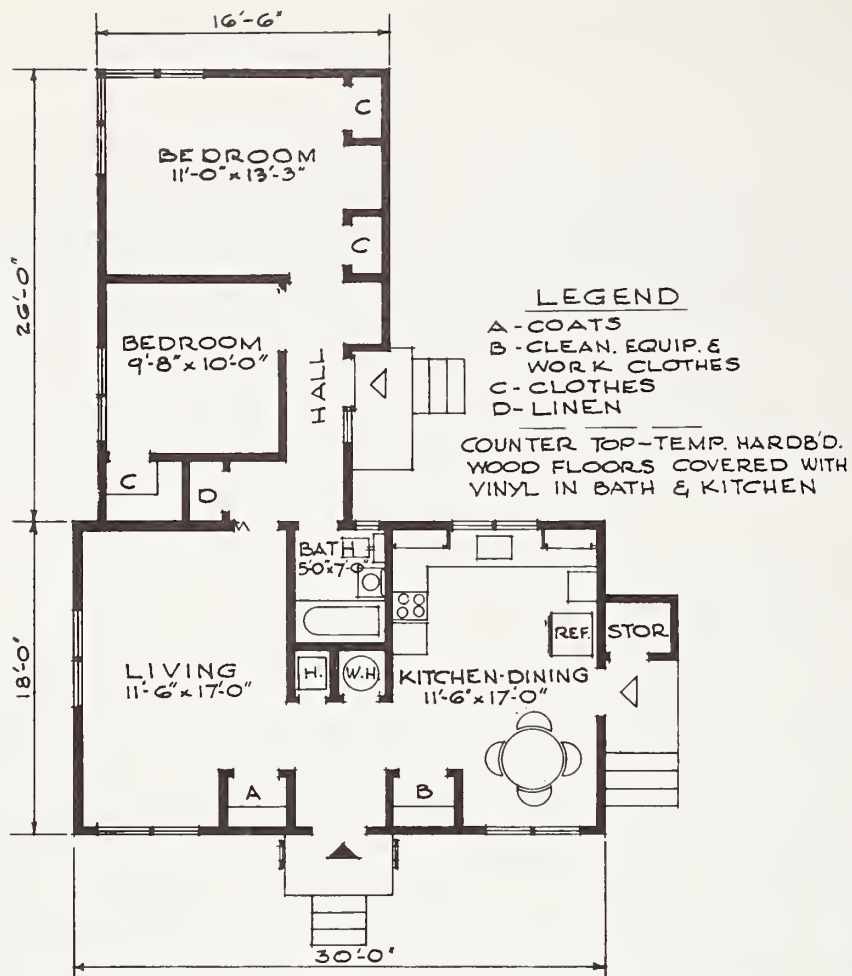


FIGURE 9.--House C.

Comments and criticisms by occupants.--

- (a) Some closure for the doorway leading to the bedroom wing is desirable to help keep the front part of the house warm in winter. (Note: A folding door was installed subsequently by the occupants.)
- (b) Floors are cold and windows drafty in winter; however, the heating system appears to provide comfort and presents no problem of disturbing the sleep of the occupants.⁸
- (c) Kitchen is dark on cloudy, dull days.⁹
- (d) Louvered shade screening provides privacy and greater comfort during the summer months.

Livability

Description of interior design.--This house has a living room, U-shaped kitchen with space for washer and laundry tub or dryer, dining area in kitchen opposite the work area, two bedrooms, and bathroom. It is designed so that a third bedroom may be added.

The front door enters into a center hall formed by two closets; one serves as a coat closet (A) and the other as a utility closet for cleaning equipment and supplies and chore wraps (B). An additional utility closet is located outdoors, near the kitchen door. In the bedroom addition are three clothing closets (C)--two in the master bedroom, one in the second bedroom--and a linen closet (D).

As in House B there is a door to the outside from the bedroom hallway.

The kitchen has 6 linear feet of wall hung cabinets, with 6 feet of wall space available for additional cupboards when needed. There are 12 linear feet of counterspace and 10½ linear feet of base cabinets and drawers exclusive of under-range and under-sink storage space. The amount of wall cabinets do not quite reach the Minimum Property Standards set by the Federal Housing Administration in November 1958 (see appendix). Total kitchen shelving exceeds minimum specifications, however, and counterspace is over twice the amount required by FHA. As in Houses A and B kitchen wall cabinets have not had doors installed (see pages 5 and 7).

The master bedroom, containing 148 square feet of floor space, is larger than the minimum size recommended by the American Public Health Association for bedrooms sleeping two persons, 136 square feet (1). The second bedroom has 96 square feet; this is greater than the FHA minimum requirements of 80 square feet for a secondary bedroom (2).

This house was planned to accommodate a family with one child, or two children of the same sex. It has been occupied for the past 7 years by a family of four with a teenage boy and a 10-year-old girl. The family's previous residence contained three bedrooms, basement, attic, and porch besides the kitchen and living room.

Evaluation by occupants.--In general the homemaker was pleased with the design of the house (fig. 9). She believed the kitchen superior to any she had ever lived in, and specifically mentioned the size and location of storage and work areas as excellent. She preferred doors on the wall cabinets, however, and suggested that an electrical outlet near the sink would be convenient for using an electric mixer. Table linens were stored in the linen closet rather than in the kitchen and the homemaker found this inconvenient. She expressed a dislike for having the laundry equipment located in the kitchen; however, no laundry was done at home so further evaluation was not made.

⁸ With money available for improvements the homemaker would increase the amount of insulation.

⁹ Window area should equal at least 13 to 17 percent of floor area, according to the American Public Health Association; in kitchen of House C, window area is 13 percent of floor area and therefore, minimum.

The dining area location was described as very convenient and more desirable than in combination with the living area.

The living room was adequate for the family's activities. However, because the 10-year-old girl had no bedroom of her own, most of her studying and indoor playing was concentrated in the living room. According to the homemaker these activities would be shifted to the third bedroom if one were available.

The size of the second bedroom was considered too small by the homemaker and by the occupant of the room, the teen-age boy. Entertaining of friends, hobbies, and the like were not feasible in a room of this size and so were curtailed.

More space for children's entertaining and play definitely was needed according to the homemaker. If she were looking for another home a basement with finished recreation room would be a "must".

There are several items for which storage was not adequate: Out-of-season clothing, bedding, bathroom supplies, toilet articles, carpentry tools, and lawn equipment. Increasing the size and number of facilities for storing these items was one of the first things the family would do if this were their permanent home. Other additions would include window awnings, railing, and door shelter at front entrance, and a patio behind the kitchen accessible from the door in the bedroom wing.

Evaluation based on space standards.--Kitchen counterspace and base storage exceed by $1\frac{1}{2}$ linear feet the minimum recommended for a U-shaped kitchen with appliances positioned as they are in this house (5), but wall cabinets fall short of the minimum standards by 2 linear feet (5). As stated previously wall space is available over the range and over a base cabinet for an additional 6 feet of wall cupboards. This kitchen has even more counterspace than that required for home food preservation (3). For optimum convenience the free space between arms of a U-shaped kitchen should be between $4\frac{1}{2}$ and 6 feet (5). In House C there is 7'-6".

This house is expandable to three bedrooms; therefore, the dining area should accommodate at least six persons. The smallest area which will do this, by serving from only one end of the table and with three persons seated on each side, is 7'-0" by 8'-0" (5). The dining area in House C is too cramped--6'-8" by 7'-9".

Space 5'-0" wide is allowed for laundry equipment in the kitchen. This is enough space for an automatic washer and either a dryer or single laundry tub, but not enough to accommodate all three pieces of equipment (5).

Clearances between lavatory and toilet, lavatory and opposite wall, and toilet and opposite wall are adequate. The clearance between toilet and adjacent wall does not meet minimum requirements for this space (4). These data are summarized in the appendix.

In a two-bedroom house without separate storage facilities for out-of-season clothing, a minimum of 7'-6" of closet rod per bedroom is needed.¹⁰ The master bedroom of House C has two rods each 3'-6" long; the closet in the second bedroom has a rod 4'-3" long. Since this house is expandable to three bedrooms, 4'-0" of rod is needed in the coat closet to accommodate the good coats belonging to six family members, plus an allowance for guest's coats. The coat closet rod in House C is 3'-6" long. Total rod space available for garments stored on hangers is 14'-9" compared with the recommended 19'-0".

The linen closet is 3'-6" wide and 2'-0" deep; this will provide storage for a liberal supply of bedding and bath linens or a limited supply of all household linens--bedding, bath, table, and kitchen linens (6).

¹⁰ See footnote 5.

House D

Construction and Materials

Description.--House D (fig. 10) is of masonry construction with foundation of concrete block on concrete footings and walls of SCR brick. Kitchen walls are furred and finished with painted gypsum board; bathroom walls are exterior plywood and redwood; walls in the utility room are finished with $\frac{1}{4}$ " cement asbestos board; and the 4'-1-5/8" high partition across the bedroom balcony is made of 3/4" V-joint T&G vertical redwood siding. Other walls are exposed brick.

The roof is corrugated aluminum over 2" plank and 2" insulation board. The ceiling is exposed plank and beam.

Windows are wood framed, with fixed glass and operating sash. Casement windows were used in the kitchen; all other sash are awning type. Insulating glass was used for all windows except those around the entrance doors. These are of heavy sheet glass. The living-dining room has a 12'-0" wide floor-to-ceiling window on the south side. Bedroom windows also are floor level.

The house is heated by a forced warm air system with perimeter ducts of heavy paper (fig. 11) formed within the concrete floor slab.

Technical evaluation.--The 6" SCR brick walls, while of pleasing exterior appearance, are damp and cold on the exposed interior surfaces during winter periods when sunshine is not adequate to heat walls. Eventually these walls will be furred and an interior finish applied as originally recommended by the brick manufacturer.

Roofing nails loosened and were redriven once. Further "popping" has not occurred.

The window over the back door was covered with plywood when it was found that the clear sheet glass admitted too much heat and glare from the late afternoon summer sun.

The forced warm air system with perimeter ducts of heavy paper laid within the concrete floor appears to be the most satisfactory of the heating systems of the five experimental houses with respect to furnishing a consistent and comfortable house temperature under most weather conditions.

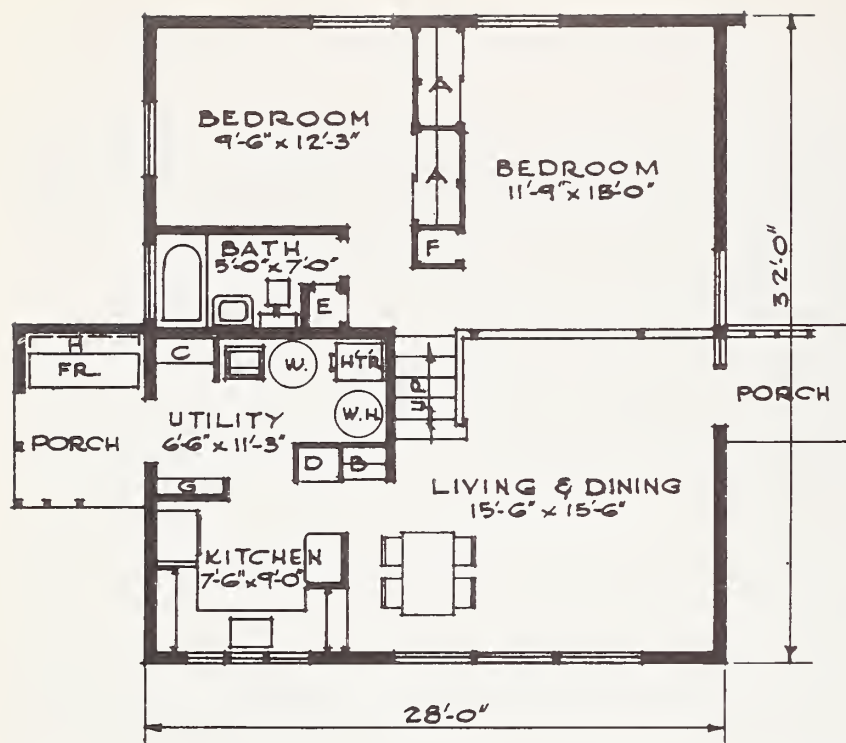
Comments and criticisms by the occupants.--

- (a) A conventional type of wall finish in lieu of the bare walls would be less cold and damp in the winter and would permit placing furniture closer to the walls.¹¹
- (b) Redwood walls in the bathroom show water stains that are difficult to remove.
- (c) A resilient tile floor covering on the upper level would be less objectionable than the present bare slab.
- (d) Windows opening at floor level are disliked because furniture cannot be placed in front of them, adequate ventilation is difficult to achieve, and small children like to swing on the open sash when they are playing out-of-doors.
- (e) The large window on the south side admits excessive light and sun.

Livability

Description of interior design.--One site in the experimental house area had sufficient natural slope to accommodate a split-level house. Because variety in design of the

¹¹If given money to spend on the house, the family would fur these walls before making other improvements.



COUNTER TOP - LAM. PLASTIC
 ASPHALT TILE, LOWER LEVEL
 EXPOSED SLAB, UPPER LEVEL



FIGURE 10, --House D.

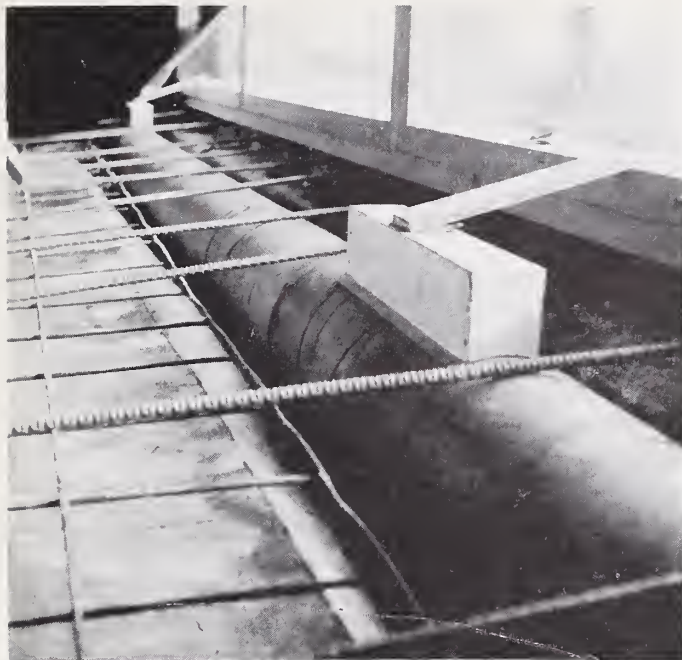


FIGURE 11.--Heating duct, House D.

experimental houses was desirable, House D was designed as a two-level home with L-shaped living-dining room, kitchen, and separate utility room on the lower level, and two bedrooms and bathroom on the upper level (see fig. 10). As originally built, the house was an example of "open planning"--only the bathroom was fully enclosed by partitions extending to the ceiling, and with a door in the doorway. The smaller bedroom had a full wall and door on the side facing the living room, but the space above the storage wall separating the two bedrooms was left open. The space was later filled in by a partition when it was found that noise transference between the two rooms was disturbing.

The larger of the two bedrooms is separated from the lower level rooms only by a waist-high solid banister. If the house should be expanded to three bedrooms, the second bedroom would be enclosed by a wall erected to form a balcony-corridor to the new bedroom.

In addition to a closet for clothing in each bedroom (A), there is a coat closet (B), chore and play clothes closet (C), utility closet for cleaning equipment and supplies (D), linen closet (E), miscellaneous storage for extra bedding, sewing supplies, toys (F), storage for canned goods (G), and an outside utility closet (H) located near the rear entrance and utility room. Extra storage space is enclosed above closets B and D for infrequently used or seasonal items.

The kitchen has 8 linear feet of wall cabinets, $8\frac{1}{2}$ linear feet of base cabinets and drawers exclusive of under-sink and under-range cabinets, and 10 linear feet of counter-space. All three exceed the Minimum Property Standards set by the Federal Housing Administration in 1958 (2). Additional storage is available in closet (G) for canned goods and other packaged goods. A pass-through to the dining area allows energy-saving meal service. Below this pass-through, utilizing corner storage space which is hard to reach from the kitchen, is a bank of drawers for storing table linens and flatware accessible from the dining area.

The area of the smaller bedroom is 120 square feet and that of the larger one, 183 square feet. Thus requirements established by the Federal Housing Administration are equaled or exceeded (2). However, the smaller bedroom is not as large as is recommended (136 sq. ft.) by the American Public Health Association, for bedroom sleeping 2 persons.

The linen closet, as in Houses A and B, was designed so that towel shelves could be reached both from the hall and from within the bathroom.

This house is suited for a family with two children of the same sex. The present occupants have 4 children, 3 girls and 1 boy between 4 and 11 years of age. They had lived in House D for 5 years prior to time of interview. They also lived in House B and before that, rented a four-bedroom house with an attic and a porch.

Evaluation by occupants.--Several features inherent in House D were not satisfactory to the homemaker occupying the house. A primary characteristic of the house design, "open planning," accompanied by limited privacy, relatively high noise level, and the unavoidable combinations of activities--at times conflicting--is of major concern to the homemaker. She is especially critical of having the larger of the two bedrooms open to the living room. This bedroom was planned as the master bedroom, but the resident family, because of its size, uses it for their four children. Criticisms by the homemaker can be attributed, at least partly,¹² to the "openness" of the design; however, the first two comments would not apply if the children could occupy the smaller, enclosed bedroom, as was intended in the design of sleeping areas. Comments were as follows:

- (a) Evening entertaining is limited because it interferes with children's sleep.
- (b) Evening television viewing is limited for the same reason.
- (c) Television in living area interferes with studying or home business done in the dining area.
- (d) Serving meals virtually in the room with the television set is a source of contention between parents and children. The homemaker would prefer dining space in the kitchen (none is available) and thinks the living-dining room is not large enough for both dining and leisure-time activities.
- (e) There is no suitable place for woodworking and other hobbies, or for activities such as sewing and indoor clothes drying, which contribute clutter. The homemaker would prefer that these, together with laundry, freezing, and ironing activities, be done in the basement, were one available. A closed-in porch is highly desired by this family and much of the entertaining, television viewing, dining and children's play activities would be done there.

The homemaker thought the utility room should be larger to accommodate automatic washer and dryer or a nonautomatic washer and double laundry tubs. She also desired space for a freezer in either the utility room or the kitchen. The family owns a freezer and keeps it outdoors in the enclosed storage area (H). Consequently, there is insufficient storage for such items as sports equipment, carpentry tools and lawn equipment.

Other items for which storage is inadequate include:

- Clothing (including coats, work clothes, other in-and-out-of-clothes)
- Bulk foods (such as potatoes)
- Bedding and table linens
- Cleaning supplies
- Sewing equipment and supplies
- Books and magazines
- Toys and hobbies

In addition, the homemaker finds storage for business papers and bathroom supplies, while quantitatively adequate, is inconvenient to use.

Special commendation was given the linen closet design (E). When the younger children lock themselves in the bathroom, a parent can easily reach the door lock by opening both doors of the linen closet.

Evaluation based on space standards.--Kitchen counterspace and base storage meet the minimum requirements established for U-shaped kitchens with appliances positioned as they are in House D (5). And if a wall cabinet were installed over the range, space requirements for wall storage would be fulfilled (see appendix). Counterspace is adequate for food preservation activity also (3).

¹² The combination of small floor area and open planning accentuates the effects of each on livability.

The dining area, part of the large dining-living room with no definite boundaries, is adjustable in dimensions and can readily accommodate the six persons who could be expected to live in the house when expanded.

In the utility room space for laundry equipment is 5'-0" wide. This is sufficient for an automatic washer and dryer or single laundry tub (5). However, all three cannot be used for this would require wall space 6'-8" wide, nor can double laundry tubs be placed beside the washer.

In the bathroom, clearances around the toilet are smaller than the amount of space recommended. Appendix tables show clearances around fixtures in House D as compared with those recommended by housing research workers (4).

Each bedroom clothes closet has rod space 4'-9" long. The minimum rod length recommended for clothes closets in a two-bedroom house when no other provision is made for out-of-season clothes is 7'-6" per bedroom.¹³

Since House D is expansible to three bedrooms, a coat closet with rod 4'-0" long is required to accommodate the good coats belonging to six family members, plus an allowance for guests' coats.¹³ Depth of a coat closet should be 2'-3".¹³ In this house the closet measures 2'-0" wide by 1'-7" deep.

Total rod space available for garments stored on hangers is 11'-6"; this compares unfavorably with the 19'-0" recommended for a house of this size.

The linen closet is 1'-10" square; this is too small--one approximately 2'-8" by 1'-8" is needed to store a limited supply of bedding and bath linens (6). However, supplementary space is available for linens in closet (F).

House E

Construction and Materials

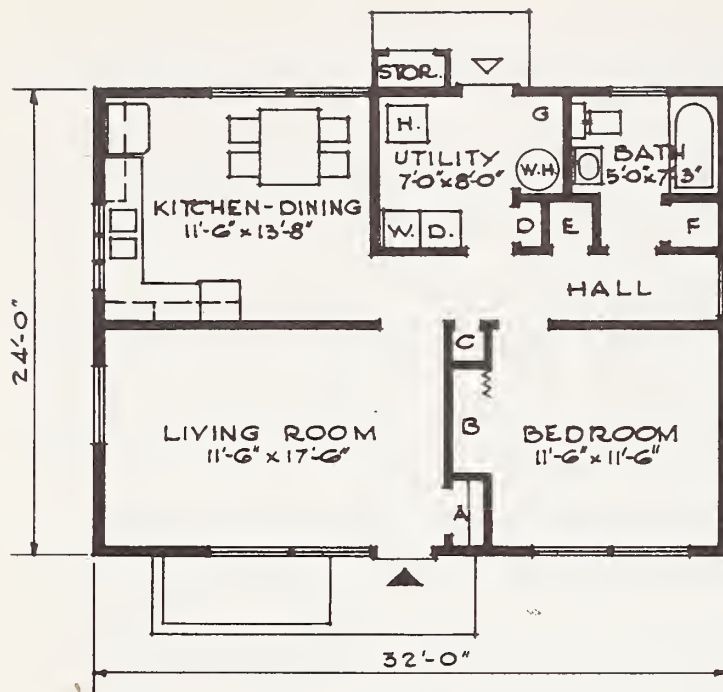
Description.--House E, commonly referred to as the aluminum house (fig. 12), incorporated certain materials furnished by industry. The exterior wall surfaces are corrugated aluminum; between the studs is foil aluminum insulation (fig. 13) and on the interior face of studs, a combination aluminum insulation and vapor barrier is used. The corrugated aluminum roofing is supported by 2-inch thick fiberboard roof decking (fig. 14) applied to trusses 4'-0" o.c. The fiberboard decking serves as insulation, with its underside exposed as ceiling, except in bath, hall, and utility room where perforated aluminum is used. Its strength was sufficient to support workmen when the aluminum roofing was installed.

Plywood is used on all interior walls except on a portion of the utility room and bath. The utility room walls are partly covered with asbestos-cement board and the bath walls with hardboard. The plywood was given a coat of white paint which was wiped off shortly after being applied. This surface was later treated with a transparent finish. The partition between the living room and the kitchen is 7'-4" high, leaving an opening of 2'-8" above it to the ceiling.

The floor is a concrete slab. The slab was covered with resilient tile approximately 1 year after completion of the house.

With the exception of one double casement window in the kitchen, windows are a combination of fixed glass and sliding aluminum sash. In the living room, dining area, and hall the sliding sash comprise the lower half and fixed sash the upper half of the window. In the bedroom there is fixed glass on both sides of the sliding sash. There are

¹³See footnote 5.



- LEGEND**
- A - COATS
 - B - CLOTHES
 - C - CLEAN. EQUIP. & SUPPLIES
 - D - FOOD STORAGE
 - E - MISC. STORAGE
 - F - LINEN
 - G - WORK CLOTHES

COUNTER TOP - LAM. PLASTIC
VINYL TILE ON CONC. FL. SLAB



FIGURE 12.--House E.



FIGURE 13.--Foil aluminum insulation, House E.



FIGURE 14.--Fiberboard roof decking, House E.

several large window areas in this house: In the living room one facing north is 8'-0" wide by 6'-8" high and extends to the floor, another window facing east is 4'-0" wide and extends from floor to ceiling. In the dining area the glass area measures 8'-0" wide by 6'-8" high with the sill $3\frac{1}{4}$ " from the floor--a southern exposure. The bedroom window faces north and is 8'-0" wide by 3'-6" high and has a sill height of 3'-1 $\frac{1}{2}$ ".

An air-to-air heat pump provided heating and cooling in this house until the summer of 1958. A forced-air oil-fired furnace using the same duct system was then installed.

Technical evaluation.--Both siding and roofing appear to be holding well with no evidence of nails "popping". The original high luster of the aluminum sheets has dulled so that its appearance blends pleasantly with the soft-colored trim.

The fiberboard roof decking serves efficiently as insulation and shows no signs of sagging or other deterioration. Interior walls have retained their semisatin finish, the resilient tile floor is giving good service, and the heating unit which replaced the heat pump provides uniform trouble-free heating.

Aluminum sliding sash operate easily in all rooms. The screen fasteners used proved too fragile; some have been damaged and loosened, so screens do not fit properly. This allows flies and other insects to enter the house.

Comments and criticism by occupants.--

- (a) Better insulation over the perforated aluminum ceiling in the bathroom is desired for temperature control and sound absorption.
- (b) A floor-to-ceiling wall between the living room and kitchen would be more satisfactory than the present partial partition.
- (c) A door between the utility room and the hall would help buffer operating noise of furnace.
- (d) High ceilings, the location of warm air vents high on walls, and large window areas all appear to contribute to the difficulty experienced in keeping the house comfortable in cold weather.
- (e) Smaller window areas throughout the house would be more pleasing. Specifically, floor-level operating sash in living room and dining area are not so satisfactory to the occupants as sash of conventional sill height because they reduce the amount of wall space available for furniture.
- (f) The ceiling-high east window was objectionable to the occupant because of the fading effect of the sun on the living room rug and furnishings. This was remedied by covering the upper section of glass with plywood on the interior and hardboard on the exterior.

Livability

Description of interior design.--House E contains a living room, kitchen with dining space, a bedroom, bathroom, and utility room (fig. 12). There are six interior closets, for: Coats (A), other clothes (B), cleaning equipment and supplies (C), food storage (D), miscellaneous storage (E), linens (F), plus space for work clothes (G). An additional utility-type storage unit is located outdoors accessible from the utility room.

Workspace in the kitchen is arranged in an "L". There are 12 linear feet of wall cabinets, 5 feet of which are over the range and refrigerator. There are 7'-3" of base cabinets, including a circular corner cabinet but excluding under-range and under-sink storage areas. Counterspace totals 8 linear feet. These three facilities in House E each exceed the FHA minimum requirements (2) by 5 square feet (see appendix).

The bathroom window is located so that it can be operated without reaching over any of the fixtures. The door into the bathroom may be placed so that the linen closet is accessible either from the hall or from the bathroom.

The bedroom area is 132 square feet, just below the American Public Health Association's recommended minimum for bedrooms sleeping two persons, 136 square feet (1), but above that of the Federal Housing Administration for the master bedroom, 120 square feet (2).

This house, with one bedroom, is suited to a couple with no children. It has been occupied for 3 years by an elderly couple whose former home for 17 years was a one-bedroom apartment.

Evaluation by occupants.--The homemaker is particularly pleased with the kitchen, dining, utility, and bathroom areas. She has space in the kitchen for her freezer and in the utility room for an automatic washer and dryer. The kitchen-dining area combination room is liked and much preferred to a living-dining combination room. The location of the linen closet, between the hall and bathroom, was appreciated for the convenience and increased privacy that it affords. The homemaker suggested that an electrical outlet placed near or on the range would be desirable; the nearest one is 3'-0" away. Also, additional storage space in the utility room for canned goods is needed. If the house had a basement, canned goods would be stored there; also, the canning activity would take place in the basement.

The living room is adequate for the family's entertaining, television viewing, and other leisure-time activities. The bedroom was described as "small." Satisfactory furniture arrangements are believed difficult to achieve in both living room and bedroom, principally because of window design (see page 24.)¹⁴

Storage was generally satisfactory; however, units for coats and bedding are inadequate and that for luggage is inconvenient for this family's needs.

Evaluation based on space standards.--Kitchen wall and base storage units and counter area are equal to or greater than the minimum recommended (5) for an L-shaped kitchen with appliances positioned as they are in this house (see appendix). For home food preservation two counters 36" wide are needed (3); this kitchen has one 36" counter and one 30" counter.

House E is expandable to three bedrooms; therefore the dining area should accommodate six persons. Such a dining area would require space of at least 7'-0" by 8'-0" (5); this is available in House E.

The utility room is adequate in size for automatic laundry equipment (5). At present such equipment is installed in the house. However, a desirable place for a laundry tub is not available unless the furnace is relocated beside the water heater.

Clearances between bathroom fixtures exceed the minimum required (4) by 6 to 8 inches. However, space between the toilet and adjacent wall and between the lavatory and adjacent wall are 3 and 5 inches, respectively, less than that required (see appendix).

The coat closet in a house expandable to three bedrooms should be large enough to store the good coats of six family members, with space for some guests' coats. Such a closet has 4'-0" of rod space and is 2'-3" deep.¹⁵ House E's coat closet is 3'-6" wide, but only 1'-10" deep.

¹⁴ This homemaker's solution for the living room would be to have the lower panes of the 8' 0" wide window removed and the space filled in, possibly with built-in bookcases; then the upper fixed panes would be replaced with operating sash to provide ventilation.

¹⁵ See footnote 5.

A bedroom closet for husband and wife should have a rod 7'-6" long;¹⁵ in this house it is only 5'-8" long.

The linen closet in House E is 2'-7" wide by 2'-3" deep and can hold the "limited" supply of bedding and bath linens (6).

CONCLUSIONS AND RECOMMENDATIONS

The five expansible farmhouses, simple in design and with well-kept lawns and plantings, present a pleasing view to visitors at the Agricultural Research Center, Beltsville, Md.

Variations from conventional siding and roofing materials have produced satisfactory results at lower cost. With periodic painting and attention to minor repairs when needed, it is reasonable to assume that the overall maintenance of these houses will be very low over a long period of time.

The grade beam foundation used on House A is satisfactory as applied in this experiment in 1952. Since then it has been adopted widely, and its use was recently approved and incorporated in the Minimum Property Standards of the Federal Housing Administration.

From the occupants' point of view, the house proving most satisfactory in respect to construction and building materials was the frame structure (House C) built along conventional lines with a wood floor supported by joists resting on brick piers. This house also was conventional in window design, using double-hung sash, and in expanse of glass, with no windows at floor level.

Large glass areas reduce the amount of wall space available for furniture. Compensating for the decreased amount of wall by placing furniture in front of windows is not satisfactory when operating sash are at floor level, as in Houses D and E, because of interference with ventilation and inaccessibility of operative hardware. Thus, satisfactory furniture arrangements are difficult to achieve; therefore, if wall space is limited, special consideration in planning must be given to room dimensions, doorways, and built-in features. Enough space for a variety of furniture arrangements in living areas and bedrooms was desired by all five homemakers.

Another criticism of large glass areas was the amount of sunlight entering which caused fading of furnishings and heat and glare. These faults can be controlled, however--inside, by adequate draperies; outside, by trees, awnings, and roof overhang, which is especially effective with a southern exposure.

A question exists whether large glass areas are suitable for small low-cost homes. Cost of draperies, the decreased amount of wall space for furniture arrangements, and uncertain acceptability by people in the market for low-cost housing make their suitability debatable.

The livability survey indicated that the families generally wanted larger rooms and storage facilities. Only the family in House B, composed of fewer members than the house was designed for, did not express a need for another room, and did not miss having a porch. A porch can substitute for an extra room 5 months of the year in the Washington, D.C., area. All five homemakers wanted a basement. It would be used for storage and both work and play activities.

Storage facilities other than those in the kitchens were often smaller than the minimums now being recommended as a result of new housing research. Closets for household linens in Houses A and D, and for clothing in Houses A, C, D, and E, measure below minimum recommendations. Clothing storage space in House D is especially inadequate. The total rod space available for garments stored on hangers is 7'-6" less than those

¹⁵ See footnote 5.

recommended; the coat closet alone is 2'-0" shorter and 8" shallower than recommended. Families living in Houses B, C, and D stored more kinds of items than did the other families. The two families with children, C and D, found storage to be inadequate and/or inconvenient for more kinds of items than did the others. More families mentioned storage for lawn equipment to be inadequate than for any other item.

A well-designed kitchen can be achieved in a small low-cost house. Occupants were generally pleased with their kitchens. Wall cabinets, base cabinets, and counterspace were found to approximate, and in several instances to exceed, minimum dimensions recommended by housing research workers. There was one exception: In House C there are only 6 linear feet of wall cabinets--8 linear feet are desirable. However, wall space is available over the range and a base cabinet for an additional 6 feet of cabinets. The cost-cutting device of omitting cabinet doors met with disfavor. All of the five homemakers wanted doors on the wall cabinets to keep shelves cleaner and the kitchen neater.

The location of the dining area in relation to the living room, particularly when there is space for only one dining area, is very important to the families. All of the case-study families preferred the dining and living areas separated; in House D there is no separation and this was disliked by the homemaker.

In a house without a basement the utility area should be large enough to house desired equipment and provide storage for such items as cleaning equipment and supplies, laundry supplies, reserve foods, chore and play clothes, and home maintenance tools and supplies. Each of the homemakers made suggestions as to how the utility area in her house might improved. All desired more storage space; all wanted a freezer--only in Houses C and E is there space for one in either the kitchen or utility area; and homemakers B and D desired more space in order to accommodate automatic laundry equipment and a stationary laundry tub.

Also, in a house without a basement, a large storage area accessible to the out of doors is needed for tools, lawn equipment, outdoor games, and play equipment such as bicycles.

Features of "open planning" such as partial or no walls dividing activity areas, and large window areas to make the division between indoors and outdoors less definite are sometimes economically desirable and even esthetically pleasing to the eyes of a visitor, but they can be difficult to live with. "Open planning" may seem to add a feeling of spaciousness to a small house, but the lack of privacy which results may be a more important factor to the individual family as it was with the family in House D.

By incorporating certain changes in design or size of various areas and storage facilities indicated in the preceding discussion, these houses would have increased livability and could be highly recommended.

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APPENDIX

Comparison of Space Standards with Spaces Actually Provided in the Five Expansible Farmhouses

Area or storage unit	Minimum recommendation		Amount of space in House--				
	Dimensions	Reference ¹	A	B	C	D	E
KITCHEN							
<u>Design 1: Mix center between sink and refrigerator; serve center between sink and range</u>							
Wall cabinets							
Mix center ²	3'-9"	5	4'-6"	4'-6"	3'-0"	4'-6"	
Serve center ³	4'-6"	5	7'-0"	6'-6"	3'-0"	3'-6"	
Base cabinets ⁴							
Mix center ⁵	3'-6"	5	5'-0"	5'-0"	6'-0"	4'-9"	
Serve center ⁶	4'-0"	5	5'-0"	5'-0"	4'-6"	3'-9"	
Counterspace ⁷							
Mix center							
Between turn of counter and sink	0'-6"	5	1'-6"	1'-6"	2'-9"	1'-6"	
Between turn of counter and refrigerator	2'-4"	5	2'-8"	2'-8"	2'-6"	2'-6"	
Serve center							
Between turn of counter and sink	0'-6"	5	1'-6"	1'-6"	2'-9"	1'-6"	
Between turn of counter and range	0'-8"	5	1'-6"	1'-6"	1'-0"	1'-6"	
On other side of range	1'-0"	5	1'-4"	1'-4"	0'-0"	0'-0"	
<u>Design 2: Mix center between sink and range; serve center between sink and refrigerator</u>							
Wall cabinets							
Mix center ⁸	5'-3"	5					7'-0"
Serve center ⁹	3'-0"	5					5'-0"
Base cabinets ⁴							
Mix center ¹⁰	5'-6"	5					4'-9"
Serve center ¹¹	2'-4"	5					2'-6"
Counterspace ⁷							
Mix center							
Between turn of counter and sink	0'-6"	5					1'-0"
Between turn of counter and range	2'-0"	5					3'-0"
On other side of range	1'-0"	5					0'-0"
Serve center							
Straight line	2'-0"	5					2'-6"
Counter area for home food preservation	Two 36" counters (corner may contribute 18")	3	1-32", 1-18" 1-32", 1-18" 2- 33", plus 1- 30", 1-18", plus corners plus corners corners plus corners				1'-36", 1'-30"
Total shelving	50 sq. ft.	2					
Wall shelving	20 sq. ft.	2			18 sq. ft.		
Base shelving	20 sq. ft.	2					
Countertop area	11 sq. ft.	2					
DINING AREA							
In house expansible to 2 bedrooms	7'-0"x6'-0"	5	7'-6"x8'-0"	7'-6"x8'-0"			
In house expansible to 3 bedrooms	7'-0"x8'-0"	5			6'-0"x7'-9"	Undefined	8'-0"x8'-0"
LAUNDRY AREA, WIDTH							
For automatic washer, dryer, single laundry tub	6'-8"	5	5'-0"	5'-0"	5'-0"	4'-6"	5'-0" ¹²
BEDROOMS (excluding closet area)							
Master bedroom ¹³	136 sq. ft.	1	None	172 sq. ft.	148 sq. ft.	183 sq. ft.	132 sq. ft.
Master bedroom	120 sq. ft.	2	None	172 sq. ft.	148 sq. ft.	183 sq. ft.	132 sq. ft.
Second bedroom sleeping 2 persons ¹³	136 sq. ft.	1	None	108 sq. ft.	96 sq. ft.	120 sq. ft.	None
Second bedroom	80 sq. ft.	2	None	108 sq. ft.	96 sq. ft.	120 sq. ft.	None
BATHROOMS							
Side of lavatory to center toilet	14"	4	18"	18"	15"	13"	20"
Front of toilet to opposite wall	30"	4	32"	32"	33"	28"	
Front of lavatory to opposite wall	34"	4	42"	42"	42"	39"	
Center toilet to adjacent wall	18"	4	15"	15"	15"	14"	15"
Front of toilet to opposite tub	24"	4					30"
Front of lavatory to opposite tub	30"	4					38"
Center of lavatory to adjacent wall	18"	4					13"
CLOSETS							
Linen-for bedding and bath linens	2'-8"x1'-8"	6	2'-2"x1'-6"	2'-2"x1'-6" plus 2'-0"x2'-2"	3'-6"x2'-0"	1'-10"x1'-11"	2'-7"x2'-3"

See footnotes at end of table.

APPENDIX

Comparison of Space Standards with Spaces Actually Provided in the Five Expansible Farmhouses--Continued

Area or storage unit	Minimum recommendation		Amount of space in House--				
	Dimensions	Reference ¹	A	B	C	D	E
CLOSETS--Continued							
Coat closet							
In house expansible to 2 bed-rooms	3'-6"x2'-3"	(¹⁴)	3'-0"x2'-0"	4'-0"x2'-3"			
In house expansible to 3 bed-rooms	4'-0"x2'-3"	(¹⁴)			3'-6"x3'-0"	2'-0"x1'-7"	3'-6"x1'-10"
Clothes closets in Master bedroom	7'-6"x2'-0"	(¹⁴)	5'-0"x2'-0"	6'-6"x2'-0"	7'-0"x2'-0"	4'-9"x2'-0"	5'-8"x2'-0"
Clothes closets in second bedroom	7'-6"x2'-0"	(¹⁴)	None	4'-0"x2'-0"	4'-3"x3'-6"	4'-9"x2'-0"	None
Other closets for clothes				4'-0"x2'-0"			

¹ Numbers identify the reference as listed in the Literature Cited, p. 27.

² Stores mix supplies (flour, sugar, shortening, etc), sink center food supplies (canned food, dried food), and serve center food supplies (prepared cereals, cookies, mayonnaise, peanut butter, etc.).

³ Stores glassware, dinnerware, serving dishes, and range supplies (oatmeal, coffee, rice, etc.).

⁴ Exclusive of under sink and under range.

⁵ Stores mix utensils and tools, vegetables, and reserve supplies of flour and sugar.

⁶ Stores pots and pans, frypans, linen, bread, silver, and range tools.

⁷ Recommendations are minimum and must be adjusted so that 4'-6" to 6'-0" is available between arms of "U".

⁸ Stores dinnerware, serving dishes, mix and range supplies.

⁹ Stores glassware, sink and serve center food supplies.

¹⁰ Stores mix utensils and tools, pots and pans and frypans.

¹¹ Stores linen, bread, vegetables, and reserve supplies.

¹² If furnace is relocated beside the water heater, 8'-0" is available.

¹³ Smallest dimension of room should not be less than 10'-0".

¹⁴ Unpublished data. Space Facilities needed for the Storage of Clothing, Clothing and Housing Research Division, ARS, U.S. Department of Agriculture.

